SOIL INVESTIGATION

SAN TOMAS CHANNEL IMPROVEMENTS

SANTA CLARA COUNTY, CALIFORNIA

- For Santa Clara County Flood Control and Water District
  San Jose, California

TA
710.3
S368.S3
1971

PROPERTY OF SANTA CLARA COUNTY
FLOOD CONTROL & WATER DISTRICT

LOWNEY ▫ KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers

145 ADDISON AVENUE / PALO ALTO / CALIFORNIA 94301

JOHN V. LOWNEY, C.E.
PETER KALDVEER, C.E.
JEREMY C. WIRE, E.G.
ROBERT R. PRATER, C.E.

415 / 328-6920

July 22, 1971
109-6, PA 3080

Santa Clara County Flood Control
and Water District
516 E. Martha Street
San Jose, California 95112
Attention: Mr. Malcolm E. Burns

RE: SOIL INVESTIGATION
SAN TOMAS CHANNEL IMPROVEMENTS
SANTA CLARA COUNTY, CALIFORNIA

Gentlemen:

In accordance with your request of June 14, 1971, we have performed a soil investigation for the proposed improvements to San Tomas Channel in the vicinity of State Highway 237. Based on our work, we find these improvements feasible from a soil engineering standpoint provided our conclusions and recommendations are incorporated into the project design and construction.

Information provided by our subsurface exploration indicates fairly uniform soil conditions along the channel reach under investigation. The existing levee fills are approximately 5 to 10 feet thick and consist primarily of a stiff, silty clay of low plasticity. Because of equipment access limitations, our exploratory borings were restricted to the crests of the existing levees. The levees are underlain by 7 to 13 feet of Bay Mud that has been fully consolidated under the centerline of the levees, but is probably weak and compressible in the vicinity of the embankment toe. Soils at depths are stiff, silty and sandy clays of low plasticity. Groundwater was encountered in all of our exploratory borings at depths varying from 8.5 to 12.0 feet below the levee crests.

Our field exploration and laboratory data indicate that the soils underlying the levees have sufficient strength to permit the proposed 4-foot raising using an embankment slope inclination of 2 to 1 (horizontal to vertical) without danger of instability. However, Bay Mud often contains localized pockets of low strength soils such as peats. Hence, the rate of fill placement will need to be controlled at the time of construction to minimize the possibility of shear failures. The filling rate should not exceed two, 8-inch loose lifts per day at any location along the channel reach.

Owing the the variable compressibility of the Bay Mud beneath the levee centerline and beyond the levee toes, considerable settlements, both differential and total, should be anticipated. We estimate that a maximum of 1.7 and 1.3 feet of total and differential settlement, respectively, will occur across a typical levee section within a period of 10 to 15 years after construction. The maximum differential settlement will occur between the centerline of the existing levee and the toe of the proposed extension.

We refer you to the text of the report for detailed recommendations. If you have any questions concerning our findings, please call us.

Very truly yours,

LOWNEY/KALDVEER ASSOCIATES

J. V. Lowney

John V. Lowney

JVL:jh

Copies: Addressee (12)

SOIL INVESTIGATION

SAN TOMAS CHANNEL IMPROVEMENTS

SANTA CLARA COUNTY, CALIFORNIA

- For Santa Clara County Flood Control and Water District
  San Jose, California

TABLE OF CONTENTS

Page No.

Letter of Transmittal

TITLE PAGE

TABLE OF CONTENTS

INTRODUCTION 1

SCOPE 1

FIELD INVESTIGATION 1
- A. Surface 2
- B. Subsurface 2
- C. Geology and Seismicity 3

CONCLUSIONS AND RECOMMENDATIONS 3
- A. GRADING AND EARTHWORK 3
  - 1. Site Preparation 3
  - 2. Material for Fill 4
  - 3. Fill Placement and Compaction 4
  - 4. Construction Observation 4
- B. SLOPES 5
- C. RIGHT-OF-WAY REQUIREMENTS 6
- D. SETTLEMENTS 6
- E. SUBSIDENCE 7

LIMITATIONS 7

FIGURE 1 - SITE PLAN
FIGURE 2 - ESTIMATED ULTIMATE SETTLEMENTS BENEATH EMBANKMENTS
FIGURE 3 - GENERAL RECOMMENDATIONS FOR EMBANKMENT RAISING

APPENDIX A - FIELD INVESTIGATION A - 1
- Key to Exploratory Boring Logs
- Exploratory Boring Logs

APPENDIX B - LABORATORY INVESTIGATION B - 1
- Figure B-1, Plasticity Chart

APPENDIX C - STABILITY ANALYSES C - 1
- Figure C-1, Bay Mud Strengths Used in Stability Analyses

SOIL INVESTIGATION
FOR
SAN TOMAS CHANNEL IMPROVEMENTS
SANTA CLARA COUNTY, CALIFORNIA

INTRODUCTION

In this report we present the results of our soil investigation for the proposed improvements to San Tomas Channel in Santa Clara County, California. The project area extends from the old Mountain View-Alviso Road to approximately 1,000 feet north of State Highway 237 and from the northern extremity of the above reach to a point 1,300 feet to the west. The total reach covered by our investigation measured approximately 3,900 lineal feet.

Detailed plans for the proposed improvements have not been finalized. However, our discussions with District personnel indicate that it is presently planned to raise the existing levees along the channel approximately 4 feet to compensate for settlement of the embankments which has resulted from both areal subsidence and compression of the soft mud deposits underlying the levees. A crest width of 18 feet is proposed for the new levees. In some locations, the levees may be relocated slightly to provide a wider channel section. Raising and widening of the levees will require widening of the embankments at the base, making it necessary for the District to acquire sufficient right-of-way to permit the required widening.

SCOPE

Our investigation included a surface reconnaissance, subsurface exploration, laboratory testing, analysis of the field and laboratory data obtained and the preparation of this report. The data obtained and the analyses performed were for the purpose of developing pertinent design information for the following items:

1. Preparation of existing levees and adjacent soft natural soils for receiving new fill materials.
2. Levee slope inclination requirements.
3. Anticipated embankment settlements.
4. Filling rate requirements to maintain embankment stability during construction.
5. Right-of-way requirements for planning ultimate levee heights based on anticipated settlements due to consolidation.

FIELD INVESTIGATION

Our field investigation was performed on June 21, 22 and 23, 1971 using a truck-mounted contինous flight auger rig for drilling and sampling of soils. A total of eight exploratory borings were drilled to a maximum depth of 41.5 feet at the locations shown on the Site Plan, Figure 1. Details of our field investigation and logs of the borings are presented in Appendix A.

A. Surface

The channel reach under investigation extends northward from the old Mountain View-Alviso Road to a point 1,000 feet north of State Highway 237 and from there extends westward for a distance of 1,300 feet. The embankments forming the channel section have a crest width varying from 10 to 15 feet and side slopes varying from 1.5: 1 to 2.5 : 1 (horizontal to vertical). The crest and slopes of the existing embankments in the reach north of State Highway 237 are generally covered with a moderate to heavy growth of vegetation. South of Highway 237, the access roads have been reasonably well maintained and slopes of embankments are covered with a light to moderate growth of vegetation.

B. Subsurface

Our subsurface exploration program indicates that soil conditions are fairly uniform along the entire channel reach under investigation. All of our borings were drilled on the crests of the existing levees and encountered between 5 and 10 feet of levee fill along the entire reach. The fill is primarily a stiff, silty clay of low plasticity but is intermixed with some fine sand in isolated areas. Some small pockets of desiccated Bay Mud soils were also encountered within the fill, thereby indicating the fill may have been partly derived from dredging operations performed in the early 1960's to accomplish earlier channel improvements.

Bay Mud deposits encountered below the fill vary in thickness from 7 to 13 feet and consist of a stiff, silty clay of high plasticity. The Bay Mud has been almost fully consolidated under the weight of levee fills and has moderate strength properties. We have retraced the stress history of the mud and conclude that in areas near the toe of the embankment and beyond, it is very likely that the mud is relatively weak and unconsolidated.

The Bay Mud is underlain by a stiff, silty clay of low plasticity. In some locations, thin layers of sand were encountered between the mud and the stiff, silty clay but these were too scattered to be considered continuous.

Groundwater was encountered in all of the borings at depths varying from 8.5 to 12.0 feet below existing levee crest. The groundwater level in the area under investigation is probably influenced by both the water levels in the channel and by seasonal variations in the surface water conditions on the poorly drained land outside the channel. The relative contribution of these two factors on the groundwater level could not be determined utilizing the limited information obtained from our subsurface exploration. Fluctuations in the level of the groundwater may also occur due to variations in rainfall, temperature, and other factors not evident at the time measurements were made and reported herein.

The attached boring logs and related information depict subsurface conditions only at these specific locations and at the particular date designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations due to environmental changes.

C. Geology and Seismicity

On a regional basis, soil underlying the site consists of silt and clay deposited in a bay-margin environment in the northern part of the Santa Clara Valley. These recent deposits are estimated to be 800 to 1,000 feet thick and overlie older consolidated alluvium and hard bedrock as determined from water well logs and geophysical surveys. Some northwest trending regional faults which are possibly active (Silver Creek Fault) are present in the consolidated alluvial deposits and/or underlying bedrock about 1.5 miles east of the channel improvement, but do not cut the more recent surface deposits in the area.

Therefore, although direct surface offset along a buried fault zone is remote, the channel levees may be subjected to strong ground shaking during an earthquake. A major earthquake should be expected during the economic life of the project, possibly originating along the San Andreas Fault located about 15 miles west of the project area, or on the Hayward Fault about 6 miles to the east.

CONCLUSIONS AND RECOMMENDATIONS

From a soil engineering standpoint, the proposed improvements to the channel reach are feasible and should be constructed without excessive difficulty. The primary effect of making these improvements will be the occurrence of relatively large total and differential settlements across embankment sections due to consolidation of the compressible Bay Mud deposits under the weight of the added fill. These settlements will have to be considered in planning the desired long-term crest elevation and in acquiring sufficient right-of-way for the improvements.

Our recommendations for the soil and foundation engineering aspects of the project are presented below and are based on our field and laboratory investigations, and analyses of the data obtained by and available to us.

A. GRADING AND EARTHWORK

1. Site Preparation

At the time of our field investigation, the crests of the existing levees to the north of State Highway 237 were covered generally with a moderate to heavy growth of vegetation. Side slopes of all embankments supported a light to moderate vegetation cover. Root systems of the vegetation extend to depths varying from approximately 4 to 12 inches. Hence, prior to the start of grading operations, the existing levees and adjacent natural ground on which fill is to be placed should be stripped to a minimum depth of 6 inches, or to such greater depth determined necessary by the soil engineer at the time of construction. Where existing channel slopes will remain unaltered, no stripping will be required. Stripped materials are unsuitable for use as fill and should be removed from the site.

The exposed soils in all areas to receive structural fill in conjunction with the channel improvements should be scarified to a minimum depth of 6 inches, moisture conditioned and compacted to the requirements given below under Item A.3., "Fill Placement and Compaction".

2. Material for Fill

Imported fill material required to raise and enlarge the existing levees should be predominantly granular with a plasticity index of 15 or less. It should not contain any rocks or lumps greater than 6 inches in maximum dimension with no more than 15 percent larger than 2.5 inches.

It is our understanding that several potential borrow sources are being considered for the improvements. At present, however, the most likely source appears to be the stockpile of excavated soils derived from the recent widening of Coyote Creek west of Highway 17 in San Jose. These materials consist primarily of sandy silts, well graded silty sands and low plasticity silty clays, all of which are suitable for use as structural fill for this project. All fill material should, however, be approved by the soil engineer prior to use.

3. Fill Placement and Compaction

All structural fill should be compacted in lift thicknesses not exceeding 8 inches before compaction or 6 inches after compaction. Fill should be compacted to a minimum degree of compaction of 90 percent of the maximum dry density as determined by ASTM Test Designation D 1557-70. Embankments should be constructed in such a manner to ensure adequate compaction out to the finished surfaces of slopes. One method by which this may be accomplished is to over-build the slopes and later trim them back to design grades. Fill material placed for raising the embankments should be keyed into the existing slopes by cutting horizontal benches in the existing slopes as the fill is brought up in horizontal lifts from the outside toe of the embankments.

It is probable that the soils outside the toes of existing levees will not be sufficiently strong to support construction equipment. Where such soft conditions are encountered, it may be necessary to bridge the soft soils with an 18 to 24-inch thick mat of uncompacted fill to provide a working base on which equipment can operate.

Our analyses indicate that the Bay Mud in its present state has sufficient strength to support the weight of the proposed additional fill. Hence, stringent control of the filling rates does not appear to be necessary. However, our experience with Bay Muds has shown that small weak zones are often present within the mud layer and if loaded too rapidly, localized shear failures can occur. We therefore recommend that the filling rate be controlled by the soil engineer in the field at the time of construction. In no case should the filling rate be permitted to exceed two, 8-inch loose lifts per day at any location along the channel reach.

4. Construction Observation

All grading and earthwork should be performed under the observation of our representative to assure proper site preparation, selection of satisfactory fill materials, as well as placement and compaction of the fills. Sufficient notification prior to earthwork operations is essential to make certain that the work will be properly observed.

Variations in soil conditions are possible and may be encountered during construction. In order to permit correlation between the preliminary soil data and the actual soil conditions encountered during construction and to ensure conformance with the plans and specifications as originally contemplated, it is essential that we be retained to perform continuous or intermittent review as required during the earthwork, excavation and foundation phases of the work. We assume no responsibility for construction compliance with the design, specifications or recommendations unless we have been retained to perform on-site review during the course of construction.

B. SLOPES

Our field exploration and subsequent laboratory testing and engineering analyses indicate that the natural soils underlying the center of the existing levees exhibit moderate strength and compressibility. The strength of these soils is, however, likely to decrease with distance from the centerline of the existing embankment. We have made a study of the probable stress history in the muds following construction of the existing levees and have based our strength estimates on the results of this study in conjunction with strength data obtained by laboratory testing.

Stability analyses were performed for both the "immediately after construction" and "long-term" conditions. These analyses indicate that the finished levees would be sufficiently stable under all loading conditions if constructed with side slopes of 2:1 (horizontal to vertical) or flatter. Details of our method of analysis are presented in the attached Appendix C. The following table summarizes the results of our stability analyses for conditions of:1) normal condition, water at levee toe, 2) surcharge by construction or maintenance equipment, 3) rapid drawdown of the channel water level of 8 feet and 4) seismic loading, horizontal and vertical.

TABLE 1, RESULTS OF STABILITY ANALYSES FOR 2:1 SLOPE INCLINATION

	Factors of Safety		
Loading Condition	Immediately After Construction	Long-Term	Minimum Recommended (Long-Term)
Normal Condition, Water at Levee Toe	1.5	2.0	1.6
Rapid Drawdown of 8 Feet	1.4	1.8	1.3
Construction or Maintenance Equipment			
(a)2-foot Fill Surcharge	1.4	1.8	1.5
(b) 33-ton Crane (1c.y. bucket)	1.1	1.5	1.4
(c) 70-ton Crane (2c.y. bucket)	0.9	1.3	1.3
Seismic (0.1 g, horizontal and vertical)	1.1	1.5	1.2
Seismic (0.2 g, horizontal and vertical)	0.9	1.2	1.1

The long-term condition should take approximately 10 years to develop. However, roughly two-thirds of the increase in stability should occur within the first two years after construction. The factor of safety may be interpolated between these two conditions.

Based on our analyses, we recommend that the side slopes of the proposed levee additions be constructed at an inclination no steeper than 2:1. However, as can be seen in Table 1, we caution that the use of heavy equipment during construction of the raising will be hazardous due to marginal stability.

In order to minimize erosion of slopes, we recommend that they be planted with a vegetation cover. In addition, provisions should be made to prevent ponding of water on the levee crest or toe. The levee crest should be sloped to drain away from the channel to minimize inboard slope and crest lip erosion. As shown in Figure 2, however, drainage should not be over-compensated since differential settlement of approximately 0.5 foot is ultimately expected between the inboard and outboard lips.

C. RIGHT-OF-WAY REQUIREMENTS

For a 4-foot embankment raising,a new crest width of 18 feet, and the continued use of 2:1 (horizontal to vertical) side slopes, on the average the toe of the new embankment will extend 22 feet beyond the toe of the existing embankment. This is just adequate to provide for the relocated embankment toe. Variations in the height, width and location of the existing levees, should, however, be taken into account in establishing the exact amount of additional land required in any given area. Regional subsidence, as indicated below, is now occurring at an almost negligible rate. Should subsidence continue to follow the present trend, no additional land should be required to allow for future levee raisings necessitated by this cause.

D. SETTLEMENTS

Soils underlying the existing levee have been almost fully consolidated under the weight of the embankment fills and are relatively incompressible when compared with the unconsolidated muds outside the toes of the existing embankments. Hence, considerable differential settlement across the embankment section should be anticipated. Our analyses indicate that a maximum total post-construction settlement of approximately 1.7 feet can be expected near the toe of the new fill with a maximum differential settlement across the embankment section of approximately 1.3 foot. We also estimate that this settlement will be completed within 10 to 15 years after construction. A profile of estimated ultimate settlements across the idealized embankment section has been prepared and is presented on Figure 2.

The anticipated settlements are fairly large and will undoubtedly need to be considered in the design of the improvements. The settlements can be compensated for by initially raising the levee to a level such that the ultimate levee crest elevation would not be below the design elevation. Otherwise, provisions may be made for periodic raising of the levees to maintain the desired crest elevation.

E. SUBSIDENCE

Surface elevations in the vicinity of the project area have been monitored by the District since 1960. Periodic elevation readings taken on two bench marks, one at the intersection of San Tomas Creek with State Highway 237 and the other approximately one-half mile north of this intersection indicate that during the period of 1960 to 1969, subsidence occurred at an average uniform rate of 0.3 foot per year.

However, between 1969 and 1970, virtually no subsidence was recorded at the bench mark located at the intersection of San Tomas Creek and State Highway 237 and only 0.04 foot of subsidence was recorded at the bench mark to the north. This is partly due to the fact that the District has, since 1965, enhanced the groundwater recharge and water importation programs.

Based on the above information, if the current negligible subsidence rate continues, future ground subsidence at the site should be minimal. This would eliminate the necessity for raising the levees in the future other than that required by consolidation settlements. However, among other things, the control of subsidence will be largely dependent upon the future policies and requirements of the District with respect to groundwater extraction by pumping overdraft and continued groundwater recharge.

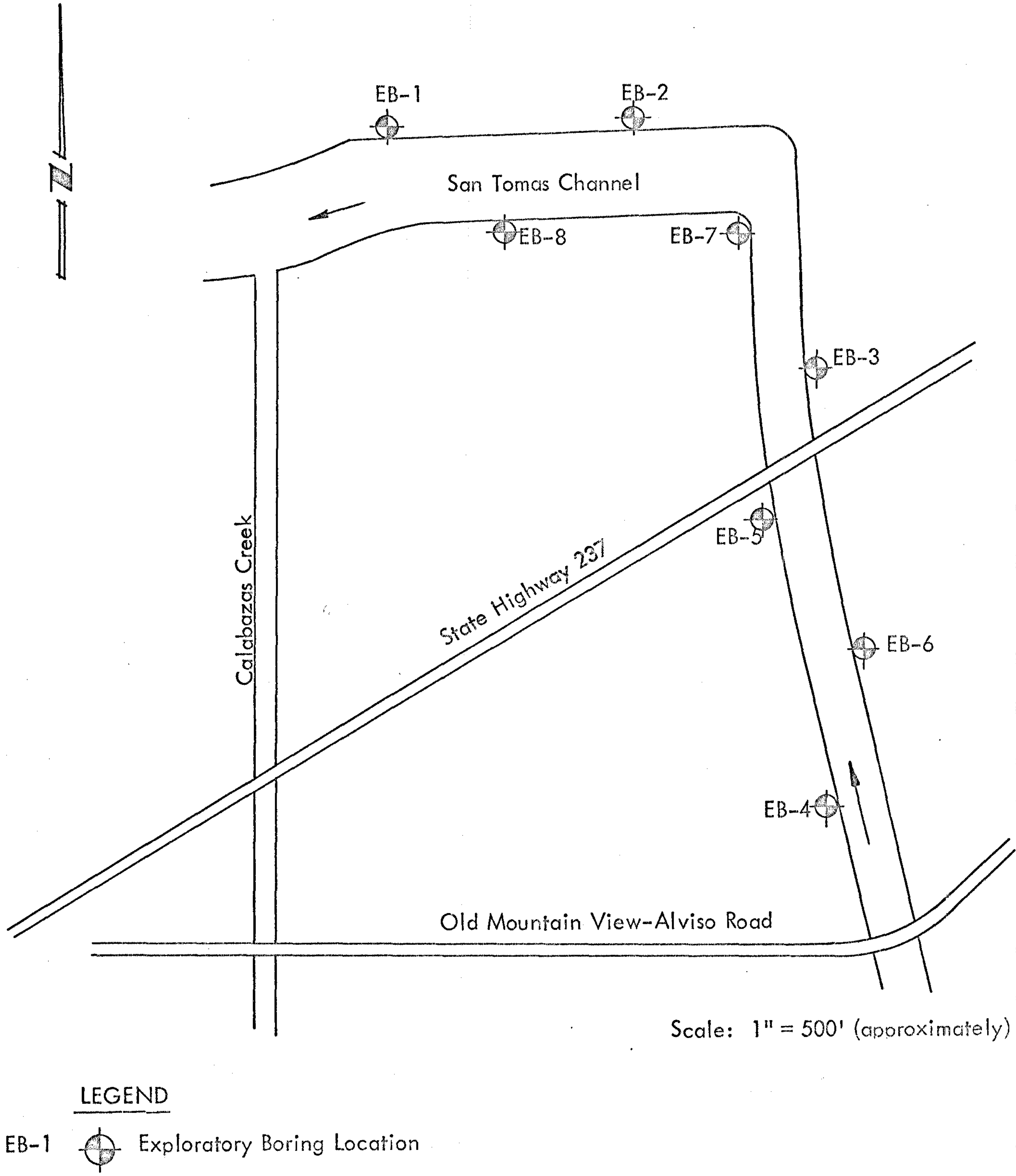
LIMITATIONS

Our services consist of professional opinions and recommendations made in accordance with generally accepted soil and foundation engineering principles and practices. This warranty is in lieu of all other warranties either express or implied.

Unanticipated soil conditions are commonly encountered, cannot be fully determined by exploratory borings, and frequently require that additional expenditures be made to attain a properly constructed project. Some contingency fund is recommended to accommodate these required extra costs.

We are responsible for the conclusions and opinions contained in this report based on the data relating only to the specific project and location discussed herein. In the event conclusions or recommendations based on these data are made by others, such conclusions or recommendations are not our responsibility unless we have been given an opportunity to review and concur in such conclusions or recommendations in writing.

The analysis and recommendations submitted in this report are based upon the data obtained from the eight exploratory borings performed at the locations indicated on the site plan. This report does not reflect any variations which may occur between these borings. The nature and extent of variations between the borings may not become evident until the course of construction. If variations then appear, it will be necessary for a re-evaluation of our recommendations to be made after performing on-site observations during the construction period and noting the nature of any variations.


N
EB-1
EB-2
San Tomas Channel
EB-8
EB-7
EB-3
EB-5
Calabazas Creek
State Highway 237
EB-6
EB-4
Old Mountain View-Alviso Road
Scale: 1" = 500' (approximately)
LEGEND
EB-1 Exploratory Boring Location

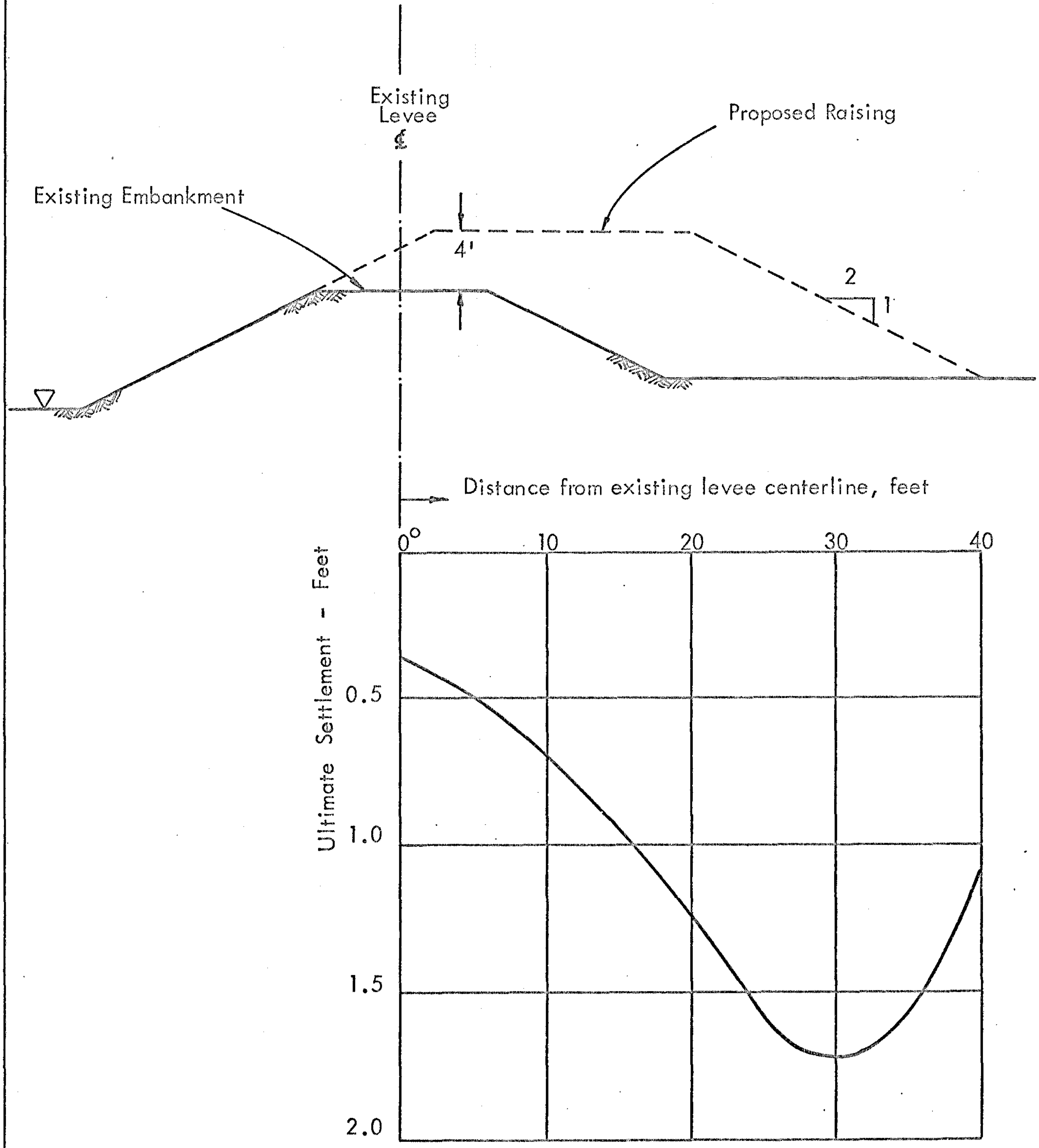
LOWNEY · KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SITE PLAN

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

PROJECT NO.	DATE	DRAWING NO.
109-6	July 1971	Figure 1



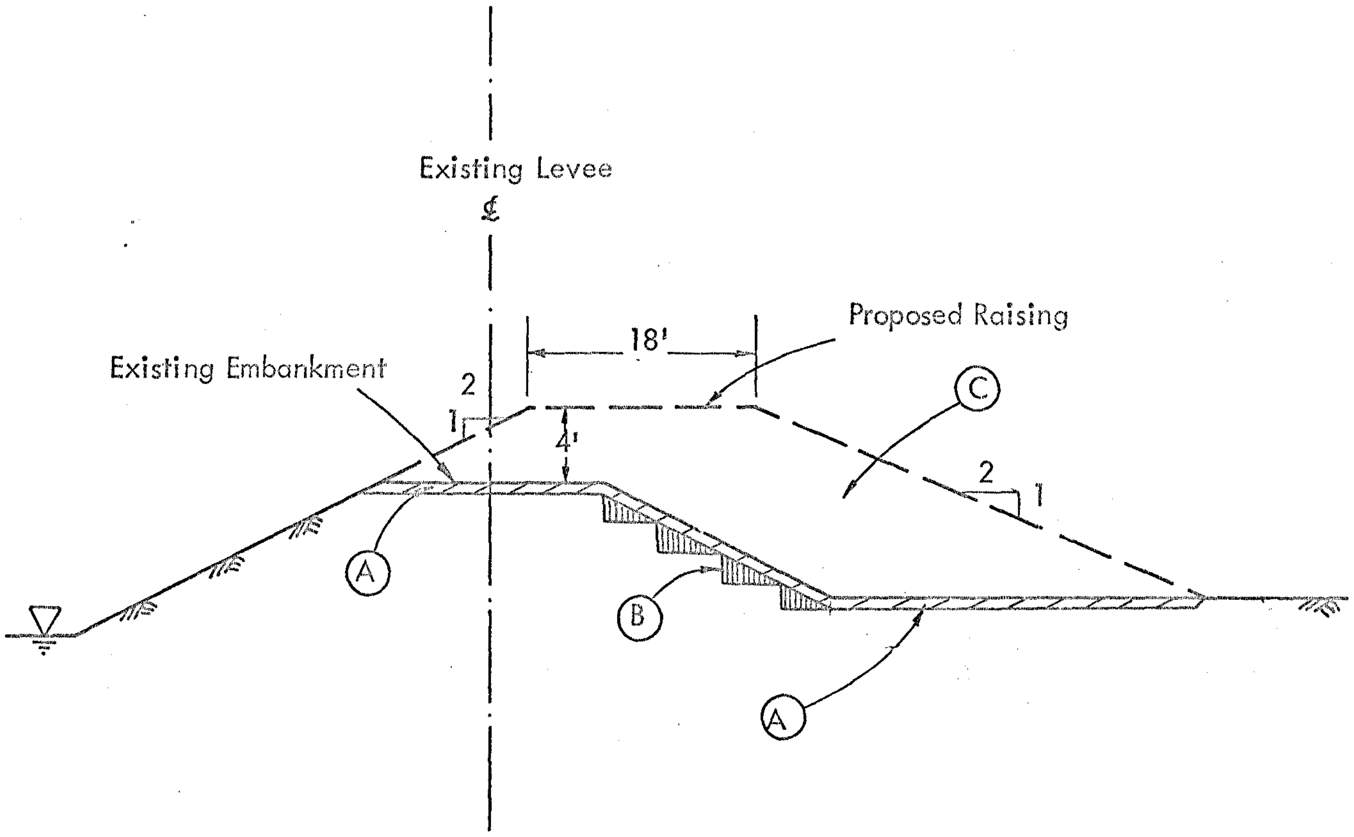
Notes: 1) Estimated settlements do not include those which may occur due to areal subsidence.
2) Primary consolidation expected to be complete in 10 to 15 years after construction.

LOWNEY · KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers
PALO ALTO, CALIFORNIA

ESTIMATED ULTIMATE SETTLEMENTS
BENEATH EMBANKMENTS

SAN TOMAS IMPROVEMENTS
Santa Clara County, California

PROJECT NO.	DATE	DRAWING NO.
109-6	September 1971	Figure 2



NOTES:

Ⓐ Zone to be stripped to minimum depth of 6 inches or as directed by Engineer.

Ⓑ Horizontal benches to be cut into existing slopes to facilitate keying of new fill into existing slopes.

Ⓒ Structural fill to be placed in lifts not exceeding 8 inches (uncompacted) and compacted to a minimum of 90 percent relative compaction as determined by ASTM Test Designation D 1557-70. Rate of fill placement to be controlled by Engineer but not more than two loose lifts per day should be placed at any location on the embankments

SCHEMATIC ONLY - NOT TO SCALE

LOWNEY · KALDVEER ASSOCIATES Foundation / Soil / Geological Engineers PALO ALTO, CALIFORNIA	GENERAL RECOMMENDATIONS FOR EMBANKMENT RAISING SAN TOMAS CHANNEL IMPROVEMENTS Santa Clara County, California		
	PROJECT NO.	DATE	DRAWING NO.
	109-6	July 1971	Figure 3

APPENDIX A - FIELD INVESTIGATION

The field investigation consisted of a surface reconnaissance and a subsurface exploration program using a truck-mounted, continuous flight auger. A total of eight, 6-inch diameter exploratory borings were drilled on June 21, 22 and 23, 1971 to a maximum depth of 41.5 feet at the site. The locations of the exploratory borings are shown on the Site Plan, Figure 1. The soils encountered in the borings were continuously logged in the field by our representative and described in accordance with the Unified Soil Classification System (ASTM D-2487). The logs of the borings as well as a key for the classification of the soil are included as part of this appendix.

Representative disturbed and undisturbed soil samples were obtained from the borings at selected depths appropriate to the soil investigation. All samples were transmitted to our laboratory for evaluation and appropriate testing.

The standard penetration resistance blow counts were obtained by dropping a 140-pound hammer through a 30-inch free fall. The 2-inch O.D. split spoon sampler was driven 18 inches and the number of blows recorded for each 6-inch penetration. The blows per foot recorded on the boring log represent the accumulated number of blows that were required to drive the final 6-inch penetration intervals. Undisturbed samples were obtained by pushing thin-walled Shelby tubes into the soil at the bottoms of borings using hydraulic pressure from the drill rig.

The boring logs show our interpretation of the subsurface conditions at the dates and locations indicated, and it is not warranted that they are representative of subsurface conditions at other locations and times.

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS MORE THAN HALF OF MATERIALS IS LARGER THAN #200 SIEVE SIEZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN #4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.
			GP	POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.
		GRAVEL WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURE. NON-PLASTIC FINES.
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES. PLASTIC FINES.
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN #4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
			SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES.
		SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES. NON-PLASTIC FINES.
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES. PLASTIC FINES.
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE	SILTS & CLAYS	LIQUID LIMIT IS LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.
	SILTS & CLAYS	LIQUID LIMIT IS GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS.
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
	HIGHLY ORGANIC SOILS		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS.

DEFINITION OF TERMS

GRAIN SIZES

U.S. STANDARD SERIES SIEVE — CLEAR SQUARE SIEVE OPENINGS

200 — 50 — 16 — 4 — 3/4" — 3" — 6"

SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

MOISTURE CONDITION (INCREASING MOISTURE ⟶)

DRY — SLIGHTLY DAMP — DAMP — (PL) — MOIST — VERY MOIST — WET (SATURATED) (LL)

CONSISTENCY

CLAYS & SILTS	BLOWS/FOOT*	STRENGTH‡
Very Soft	0 - 2	0 - 1/4
Soft	2 - 4	1/4 - 1/2
Firm	4 - 8	1/2 - 1
Stiff	8 - 16	1 - 2
Very Stiff	16 - 32	2 - 4
Hard	Over 32	Over 4

RELATIVE DENSITY

SANDS & GRAVELS	BLOWS/FOOT*
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).

‡ Unconfined compressive strength in tons/sq ft. Read from a pocket penetrometer.

LOWNEY & KALDVEER
Foundation/Soil/Geological Engineers

PALO ALTO, CALIFORNIA

KEY TO SOIL BORING LOGS
Unified Soil Classification System ASTM D-2487

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

PROJECT NO.	DATE	DRAWING NO.
109-6	July 1971	—

DRILL RIG Continuous Flight Auger	BORING ELEVATION – – –	LOGGED BY A.B.
DEPTH TO GROUNDWATER 9.0 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/21/71

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, sandy with some gravel	medium to dark brown	very stiff	CL		X					24
				1						
				2						
					X					22
				3						
	light to medium brown	stiff		4						
				5						
				6	X				13	10
				7						
	gray mottled brown	firm			X					10
				8						
				9	X				▽	5
LEVEE FILL ↑				10	X					9
				11						
CLAY, silty (bay mud) with thin sand lenses	dark gray	stiff	CH		X				31	7
				12						
				13	X					9
				14						
				15				☒		
-Unconfined Compressive Strength = 1020 psf				16				☒		
				17						
				18						
				19						
CLAY, silty with some medium grained sand	tan	stiff to very stiff	CL	20						

LOWNEY·KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	1 OF 2	1

DRILL RIG Continuous Flight Auger	BORING ELEVATION ---	LOGGED BY A.B.
DEPTH TO GROUNDWATER 9.0 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/21/71

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, silty (con't)	tan	stiff to very stiff	CL	21	X				24	16
				22						
				23						
CLAY, silty	medium brown	stiff	CL	24						
				25						
				26	X				21	7
				27						
CLAY, sandy to SAND, clayey fine grained, with several lenses of medium sand	medium brown	stiff	CL-SC	28						
				29						
				30						
				31	X				19	9
Bottom of Boring = 31.5 Feet				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						

LOWNEY · KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	2 OF 2	1

DRILL RIG Continuous Flight Auger	BORING ELEVATION – – –	LOGGED BY A.B.
DEPTH TO GROUNDWATER 9.5 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/21/71

DESCRIPTION AND CLASSIFICATION				DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE							
Miscellaneous FILL, sand, gravel clay, debris	brown to gray			1	X					27
				2						
CLAY, silty	medium brown	stiff	CL	3	X					18
				4						
LEVEE FILL				5						
				6	X				32	7
CLAY, silty (bay mud) with some thin layers of peat	gray to dark gray	stiff	CH	7						
				8						
				9					▽	
-Unconfined Compressive Strength = 850 psf				10				☒		
				11				☒		
				12				☒		
				13						
				14						
				15						
				16	X				29	8
				17						
				18						
CLAY, sandy with some silt	tan	very stiff	CL	19						
				20						

LOWNEY · KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	1 OF 2	2

DRILL RIG Continuous Flight Auger	BORING ELEVATION - - -	LOGGED BY A.B.
DEPTH TO GROUNDWATER 9.5 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/21/71

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, sandy (con't)	tan	very stiff	CL	21	X				18	17
				22						
CLAY, sandy to SAND, clayey, fine to medium grained	medium brown	firm to loose	CL-SC	23						
				24						
				25						
				26	X					8
				27						
CLAY, silty	medium brown mottled gray	stiff to very stiff	CL	28						
				29						
				30						
				31	X				31	16
Bottom of Boring = 31.5 Feet				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						

LOWNEY·KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	2 OF 2	2

DRILL RIG	Continuous Flight Auger	BORING ELEVATION	---	LOGGED BY	A.B.
DEPTH TO GROUNDWATER	10.0 Feet	BORING DIAMETER	6 Inches	DATE DRILLED	6/21/71

DESCRIPTION AND CLASSIFICATION				DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE							
SAND, fine to medium grained, trace of silt	light gray	medium dense	SP	1	X					17
				2	X					11
SILT, sandy with some clay, several thin layers of medium sand, some pockets of gray clay	medium brown	stiff	ML	3						
				4						
				5						
				6	X				32	11
LEVEE FILL -				7						
				8						
CLAY, silty (bay mud)	dark gray	stiff	CH	9						
				10					▽	
				11	X				30	9
				12						
				13						
				14						
				15						
				16	X				30	14
				17						
				18						
SAND, clayey, medium grained	medium brown	loose	SC	19						
				20						

LOWNEY·KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	1 OF 2	3

DRILL RIG Continuous Flight Auger	BORING ELEVATION – – –	LOGGED BY A.B.
DEPTH TO GROUNDWATER 10.0 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/21/71

DESCRIPTION AND CLASSIFICATION				DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE							
SAND, clayey (con't)	medium brown	loose	SC	21	X					2
				22						
				23						
CLAY, silty with some sand	medium brown mottled gray	stiff	CL	24						
				25						
				26	X				22	11
				27						
				28						
				29						
CLAY, sandy to SAND, clayey	medium brown	firm	CL-SC	30						
				31	X				26	6
Bottom of Boring = 31.5 Feet				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						

LOWNEY · KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	2 OF 2	3

DRILL RIG	Continuous Flight Auger	BORING ELEVATION	- - -	LOGGED BY	R.M.
DEPTH TO GROUNDWATER	11.5	BORING DIAMETER	6 Inches	DATE DRILLED	6/22/71

DESCRIPTION AND CLASSIFICATION				DEPTH	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	Ft.						
CLAY, silty	medium to dark brown	very stiff	CL	1	X				17	21
	gray brown			2	X					16
LEVEE FILL				3						
				4						
CLAY, silty (bay mud)	dark gray	stiff to very stiff	CH	5						
				6						
				7						
				8						
				9	X				29	18
				10						
				11					▽	
				12						
CLAY, sandy with some silt	medium brown	stiff	CL	13						
				14	X				21	13
				15						
				16						
				17						
SAND, clayey, fine grained	medium brown	loose	SC	18						
				19	X X					8
CLAY, silty	medium brown	very stiff	CL	20						

LOWNEY · KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	1 OF 2	4

DRILL RIG Continuous Flight Auger	BORING ELEVATION - - -	LOGGED BY R.N.
DEPTH TO GROUNDWATER 11.5 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/22/71

DESCRIPTION AND CLASSIFICATION DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, silty (con't)	medium brown	very stiff	CL							
				21						
				22						
				23			☐			
				24	X					22
				25				☒		
-Unconfined Compressive Strength = 1980 psf				26						
				27						
				28	X		☐		30	16
				29						
Bottom of Boring = 29.0 Feet										
				30						
				31						
				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						

LOWNEY · KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	2 OF 2	4

DRILL RIG Continuous Flight Auger	BORING ELEVATION - - -	LOGGED BY R.N.
DEPTH TO GROUNDWATER 10.5 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/22/71

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, silty with seams of medium grained sand	light brown	stiff	CL	1	X					11
				2						
	gray brown				X					19
				3						
				4	X				16	14
				5						
				6						
LEVEE FILL				7						
				8						
CLAY, silty (bay mud) with some organic matter	dark gray	firm to stiff	CH		X					6
				9						
				10						
									▽	
				11						
				12						
				13						
				14	X				32	7
CLAY, silty to sandy, with seams of fine clayey sand	medium brown mottled gray	very stiff	CL	15						
				16						
				17						
				18						
				19	X					19
				20						

LOWNEY·KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	1 OF 2	5

DRILL RIG Continuous Flight Auger
BORING ELEVATION – – –
LOGGED BY R.N.
DEPTH TO GROUNDWATER 10.5 Feet
BORING DIAMETER 6 Inches
DATE DRILLED 6/22/71

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, (con't)	medium brown mottled gray	very stiff	CL	21						
				22						
SAND, gravelly, coarse grained, maximum size approximately 1/2 inch	gray	medium dense	SW-GW	23						
				24	X X					14
CLAY, silty with some fine sand, trace of gravel	medium brown mottled gray	very stiff	CL	25						
				26						
				27						
				28						
				29	X				25	17
Bottom of Boring = 29.5 Feet				30						
				31						
				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						

LOWNEY · KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers
PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	2 OF 2	5

DRILL RIG	Continuous Flight Auger	BORING ELEVATION	---	LOGGED BY	R.N.
DEPTH TO GROUNDWATER	11.5 Feet	BORING DIAMETER	6 Inches	DATE DRILLED	6/22/71

DESCRIPTION AND CLASSIFICATION

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, silty	medium brown	stiff	CL	1	X					12
	gray brown			2	X				21	20
				3						
				4	X					13
				5						
				6						
				7						
LEVEE FILL ↑				8						
				9						
				10						
CLAY, silty (bay mud)	dark gray	firm	CH	11	X				30 ▽	5
				12						
				13						
				14						
SAND, clayey, fine to medium grained	medium brown	medium dense	SC	15						
				16	X					10
CLAY, silty	medium brown	stiff	CL	17						
				18						
				19						
				20						

LOWNEY · KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	1 OF 2	6

DRILL RIG	Continuous Flight Auger	BORING ELEVATION	- - -	LOGGED BY	R.N.
DEPTH TO GROUNDWATER	11.5 Feet	BORING DIAMETER	6 Inches	DATE DRILLED	6/22/71

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
SAND, silty, medium grained	medium brown	loose	SC		X					6
				21	X					
CLAY, silty with fine sand	medium brown	stiff	CL							
				22						
SAND, medium grained, clean	medium to dark brown	loose	SP							
				23						
				24						
				25						
					X					
				26	X					24
CLAY, silty with some fine sand	medium brown	very stiff	CL							
				27						
				28						
				29						
				30						
				31	X				26	27
Bottom of Boring = 31.5 Feet				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						

LOWNEY·KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers
PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
San Jose, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	2 OF 2	6

DRILL RIG	Continuous Flight Auger	BORING ELEVATION	---	LOGGED BY	R.N.
DEPTH TO GROUNDWATER	8.5 Feet	BORING DIAMETER	6 Inches	DATE DRILLED	6/22/71

DESCRIPTION AND CLASSIFICATION

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, silty	medium brown	stiff	CL	1	X		▯			11
				2						
				3						
				4						
				5			▯			
LEVEE FILL ↑				6	X		▯		24	17
				7						
CLAY, silty (bay mud)	dark gray	stiff	CH	8					▽	
				9						
				10			▯			
				11	X		▯		26	10
-Unconfined Compressive Strength = 1730 psf				12				☒		
				13				☒		
				14				☒		
				15						
SILT, sandy with a trace of gravel	dark brown	stiff	ML	16	X		▯			17
				17						
CLAY, silty with some fine sand	dark gray	stiff to very stiff	CH	18						
				19						
				20						

LOWNEY · KALDVEER ASSOCIATES

Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	1 OF 2	7

DRILL RIG Continuous Flight Auger	BORING ELEVATION – – –	LOGGED BY R.N.
DEPTH TO GROUNDWATER 8.5 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/22/71

DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, silty (con't)	dark gray	stiff to very stiff	CH	21	X				27	22
SAND, silty, medium grained	medium brown	loose	SM	22						
				23						
				24						
				25						
				26	X				25	6
CLAY, silty -Unconfined Compressive Strength = 1325 psf	medium brown mottled gray	very stiff	CL	27						
				28						
				29						
				30	X				33	17
Bottom of Boring = 30.5 Feet				31						
				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						

LOWNEY · KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers
PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	2 OF 2	7

DRILL RIG Continuous Flight Auger	BORING ELEVATION - - -	LOGGED BY A.B.
DEPTH TO GROUNDWATER 12.0 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/23/71

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, silty to SILT, clayey, with some fine sand	light to medium brown	stiff	CL-ML	1	X					16
				2	X				18	12
				3						
CLAY, silty	medium brown	stiff	CL	4						
				5						
LEVEE FILL ↑				6	X					8
				7						
CLAY, silty (bay mud) with some organic matter	dark gray	stiff	CH	8				☒		
-Unconfined Compressive Strength = 990 psf				9						
				10	X					8
				11						
CLAY, silty with some medium to coarse sand	medium brown	stiff	CL	12					∇	
CLAY, silty with some organic matter	dark gray	stiff to very stiff	CH	13						
				14						
				15						
					X					
				16	X				26	17
				17						
				18						
CLAY, silty, trace of medium sand	medium brown	very stiff	CL	19						
				20						

LOWNEY·KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers
PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	1 OF 3	8

DRILL RIG Continuous Flight Auger	BORING ELEVATION - - -	LOGGED BY A.B.
DEPTH TO GROUNDWATER 12.0 Feet	BORING DIAMETER 6 Inches	DATE DRILLED 6/23/71

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, silty (con't)	medium brown	very stiff	CL	21	X					22
				22						
SAND, silty, medium to coarse grained	medium brown	medium dense	SW	23						
				24						
CLAY, sandy to SAND, clayey with several lenses of medium grained sand	red-brown mottled gray	stiff	CL	25						
				26	X					6
CLAY, silty with some thin sand lenses	red-brown	stiff	CL	27						
				28						
				29						
				30						
				31	X				18	15
				32						
				33						
				34						
CLAY, silty	medium brown mottled gray	very stiff	CL	35						
				36						
				37						
				38						
				39						
				40						

LOWNEY · KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers
PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	2 OF 3	8

DRILL RIG Continuous Flight Auger	BORING ELEVATION - - -	LOGGED BY A.B.
DEPTH TO GROUNDWATER 12.0	BORING DIAMETER 6 Inches	DATE DRILLED 6/23/71

DESCRIPTION AND CLASSIFICATION										
DESCRIPTION AND REMARKS	COLOR	CONSIST.	SOIL TYPE	DEPTH Ft.	JARS	SACKS	SPLIT SPOON	SHELBY TUBE	MOISTURE CONTENT	PENETRATION RESISTANCE BLOWS/FT.
CLAY, silty (con't)	medium brown	very stiff	CL	41	X X				21	40
Bottom of Boring = 41.5 Feet				42						
				43						
				44						
				45						
				46						
				47						
				48						
				49						
				50						
				51						
				52						
				53						
				54						
				55						
				56						
				57						
				58						
				59						
				60						

LOWNEY·KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, County

EXPLORATORY BORING LOG

PROJECT NO.	DATE	SHEET NO.	BORING NO.
109-6	July 1971	3 OF 3	8

APPENDIX B - LABORATORY INVESTIGATION

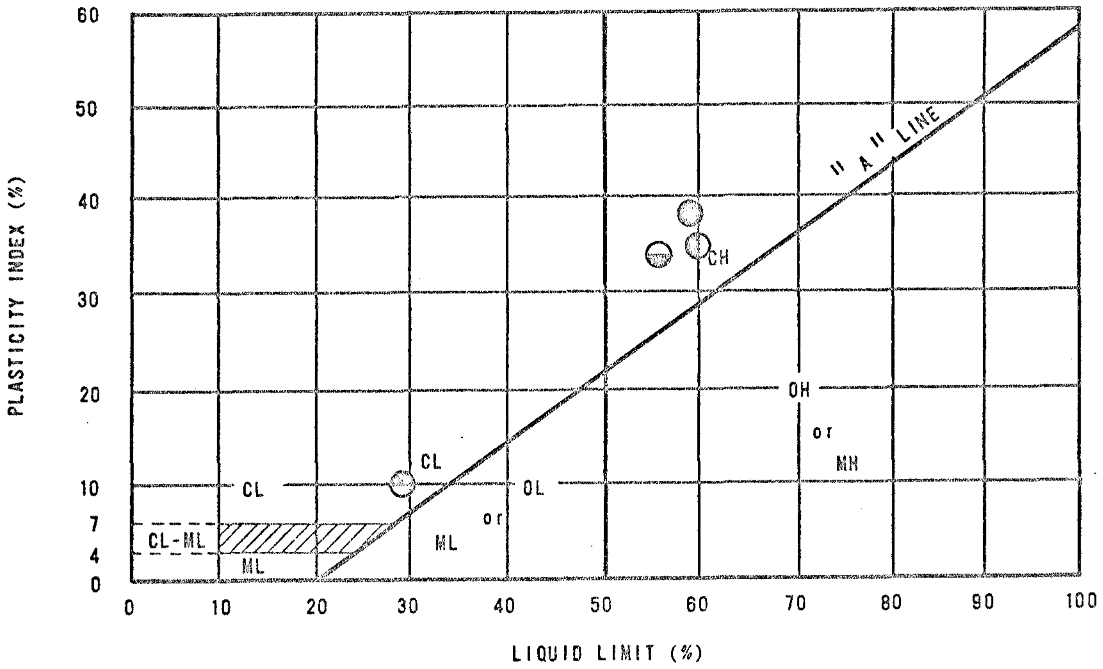
The laboratory testing program was directed toward a quantitative and qualitative evaluation of the physical and mechanical properties of the soils underlying the site to depths influenced by the foundation pressures. Index and classification tests were performed.

The natural water content was determined on selected samples of fine grained soils and is recorded on the boring logs at the appropriate depth. Since water has a significant influence on soil, the natural water content provides a rough indicator of the soil's compressibility and strength.

Four Atterberg Limit determinations were performed on representative samples of the clayey soils to determine the range of water content over which these materials exhibit plasticity and to classify the soil according to the Unified Soil Classification System. Also, much useful information can be obtained by comparing the natural water content with the plastic and liquid limits determined in the tests. Fine grained soils with field water contents near the plastic limits are generally strong and relatively incompressible while field water contents closer to the liquid limit indicate very weak compressible soils that should be handled with great care. The results of the Atterberg Limit determinations are presented on Figure B-1.

Six unconfined compression tests were performed on undisturbed samples of the fine grained soils in order to determine their strength characteristics. The results of the tests are presented on the boring logs at the appropriate depth.

PLASTICITY CHART



PLASTICITY DATA

KEY SYMBOL	HOLE NO	DEPTH (feet)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	UNIFIED SOIL CLASSI-FICATION SYMBOL
●	1	13.5	59	38	CH
◐	4	9.0	60	35	CH
◓	5	19.0	29	10	CL
◒	8	15.5	56	34	CH

APPENDIX C - STABILITY ANALYSES

The stability of a slope is dependent on forces acting on potential sliding surfaces and on the shear strength of the soil. Forces that the slope must resist include the weight of the soil, unbalanced water pressures, seeping water and the weight of spoil banks, equipment and materials. The stability of a slope may also be affected by future construction on or above the slope and by changes in internal pore pressures and outside water levels. Field experience with landslides indicates that for purposes of analysis, the failure surface can be assumed to be circular in section and infinite in width.

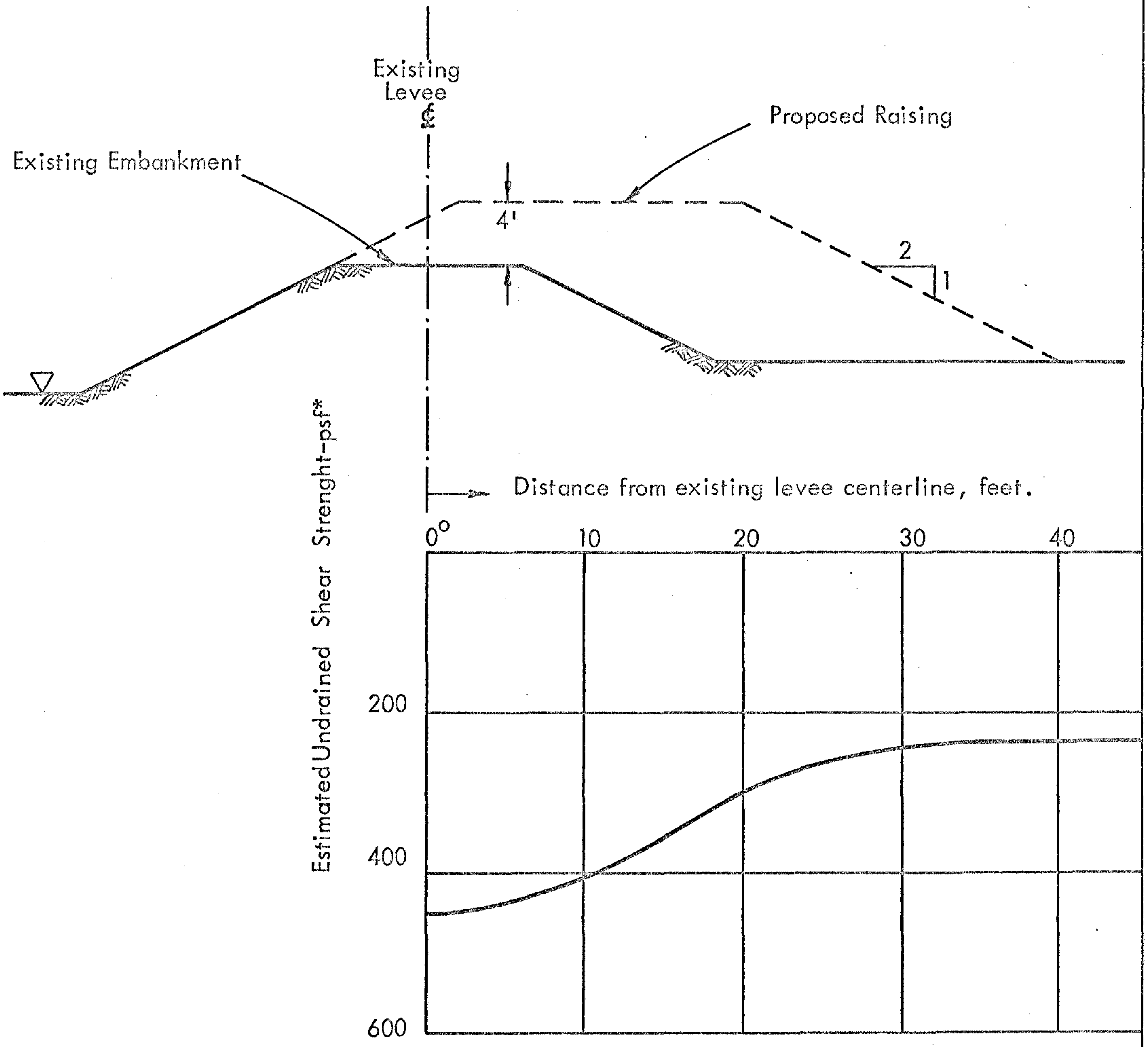
Analysis of slope stability consists of selection of a trial circular failure surface and evaluation of the forces tending to cause movement along the surface followed by determination of the shear strength that can be mobilized along that surface to resist movement. The factor of safety against slope failure is defined as the ratio of the available soil shearing strength to the shearing strength necessary to prevent instability.

Trial surfaces are assumed and analysed until a minimum factor of safety is obtained. Our analyses assumed a strength distribution for the Bay Mud as shown on Figure C-1. This distribution was based on laboratory strength data obtained by us and a correlation of this data with the probable stress history of the soil. For the existing fill materials, a shear strength of 700 pounds per square foot was considered to be representative, and for the proposed raising a friction angle of 30 degrees was used for new fill. A total unit weight of 120 pounds per cubic foot was chosen as being representative of all existing and new fill materials.

Stability analyses were performed for both the "immediately after construction" and "long-term" cases. We analysed for conditions of (1) normal condition, water at levee toe, (2) rapid drawdown. (3) seismic acceleration, and (4) for the case of construction and/or maintenance equipment on the embankments. In our analysis for the condition of seismic acceleration, a seismic force of 0.1 g and 0.2 g applied both vertically and horizontally was used. Routine equipment loads can be accounted for in design by applying either a 2-foot fill surcharge or a 480-pound live load at the top of embankments. We also performed stability analyses assuming a 70-ton and 33-ton resting on the proposed embankments. The results of all our stability analyses are summarized in the following table.

TABLE C - 1, RESULTS OF STABILITY ANALYSES FOR 2:1 SLOPE INCLINATION

Loading Condition	Factors of Safety		
	Immediately After Construction	Long-Term	Minimum Recommended (Long-Term)
Normal Condition, Water at Levee Toe	1.5	2.0	1.6
Rapid Drawdown of 8 Feet	1.4	1.8	1.3
Construction or Maintenance Equipment			
(a) 2-foot Fill Surcharge	1.4	1.8	1.5
(b) 33-ton Crane (1c.y. bucket)	1.1	1.5	1.4
(c) 70-ton Crane (2c.y. bucket)	0.9	1.3	1.3
Seismic (0.1 g, horizontal and vertical)	1.1	1.5	1.2
Seismic (0.2 g, horizontal and vertical)	0.9	1.2	1.1



* Immediately After Construction

LOWNEY · KALDVEER ASSOCIATES
Foundation / Soil / Geological Engineers

PALO ALTO, CALIFORNIA

BAY MUD STRENGTHS USED IN STABILITY ANALYSES

SAN TOMAS CHANNEL IMPROVEMENTS
Santa Clara County, California

PROJECT NO.	DATE	DRAWING NO.
102-6	September 1971	Figure C - 1